

- 1 1. High compression ratio, homogeneous charge compression ignition/spark ignition
2 dual mode engine comprising:
 - 3 a first mode employing homogeneous charge compression ignition at low- and
4 mid-load levels; and
 - 5 a second mode employing spark ignition at high load levels, the second mode
6 including the addition of hydrogen or a hydrogen/carbon monoxide mixture in the
7 engine.
 - 8 2. The engine of claim 1 wherein the compression ratio is greater than about 10:1.
 - 9 3. The engine of claim 1 operating on a low octane gasoline.
 - 0 4. The engine of claim 1 wherein the addition of hydrogen or a hydrogen/carbon
1 monoxide mixture is sufficient to prevent knock.
 - 2 5. The engine of claim 1 wherein the addition of hydrogen or a hydrogen/carbon
3 monoxide mixture increases the fuel octane number by at least 10.
 - 4 6. The engine of claim 1 further including control means for changing engine mode.
 - 5 7. The engine of claim 1 wherein the engine operates on a very lean fuel-air mixture
6 or at a stoichiometric fuel-air mixture with high EGR.
 - 7 8. The engine of claim 1 further including pressure boosting to increase engine
8 power density.
 - 9 9. The engine of claim 8 wherein pressure boosting is by turbocharging or
0 supercharging.
 - 10 10. The engine of claim 1 wherein the hydrogen or hydrogen/carbon monoxide
11 mixture is produced by a hydrocarbon fuel reformer.

- 1 11. The engine of claim 10 wherein the fuel reformer is a plasmatron reformer.
- 2 12. The engine of claim 1 wherein the hydrogen is stored in a high pressure vessel or
3 other onboard storage means.
- 4 13. The engine of claim 1 further including means for varying combustion rate by
5 stratifying the hydrogen or the hydrogen/carbon monoxide mixture.
- 6 14. The engine of claim 13 wherein stratifying the hydrogen or hydrogen/carbon
7 monoxide mixture is achieved through non-uniform or time-varying port fueling
8 or by in-cylinder injection.
- 9 15. The engine of claim 1 further including means for slowing down the combustion
10 process to reduce acoustic noise.
- 11 16. The engine of claim 1 wherein the amount of the hydrogen or the
12 hydrogen/carbon monoxide mixture is increased as engine load increases.
- 13 17. High compression ratio, homogeneous charge compression ignition engine
14 operating on a high cetane fuel along with the addition of hydrogen or a
15 hydrogen/carbon monoxide mixture at low-to-mid-load levels.
- 16 18. The engine of claim 17 wherein the high cetane fuel is diesel fuel.
- 17 19. The engine of claim 17 wherein the ratio of hydrogen or a hydrogen/carbon
18 monoxide mixture to the high cetane fuel is reduced at high load levels and the
19 engine operates in compression ignition mode.
- 20 20. The engine of claim 17 wherein the ratio of hydrogen or a hydrogen/carbon
21 monoxide mixture to the high cetane fuel is varied to achieve a selected ignition
22 delay.
- 23 21. The engine of claim 17 further including control means for changing engine
24 mode.

- 1 22. The engine of claim 17 further including pressure boosting to increase engine
- 2 power density.
- 3 23. The engine of claim 12 wherein the power boosting is by turbocharging or
- 4 supercharging.
- 5 24. The engine of claim 17 wherein hydrogen or hydrogen/carbon monoxide mixture
- 6 is produced by a hydrocarbon fuel reformer.
- 7 25. The engine of claim 24 wherein the fuel reformer is a plasmatron.
- 8 26. The engine of claim 17 wherein the hydrogen or hydrogen/carbon monoxide
- 9 mixture is contained in a high-pressure vessel or other onboard storage means.
- 10 27. The engine of claim 17 wherein the high cetane fuel is bio-oil.

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